made, the record should reflect the persistence and the regularity of the inciting rhythm.

The search of the rocks for records of the ticks of the precessional clock is an out-of-door work. Pursued as a closet study it could have no satisfactory outcome, because the printed descriptions of rock sequences are not sufficiently complete for the purpose; and the closet study of geology is peculiarly exposed to the perils of hobby-riding. A student of the time problem cannot be sure of a persistent, equable sedimentary rhythm without direct observation of the characters of the repeated layers. He needs to avail himself of every opportunity to study the series in its horizontal extent, and he should view the local problem of original *versus* imposed rhythm with the aid of all the light which the field evidence can cast on the conditions of sedimentation.

Neither do I think of rhythm seeking as a pursuit to absorb the whole time and energy of an individual and be followed steadily to a conclusion; but hope rather that it may receive the incidental and occasional attention of many of my colleagues of the hammer, as other errands lead them among cliffs of bedded rocks. If my suggestion should succeed in adding a working hypothesis or point of view to the equipment of field geologists, I should feel that the search had been begun in the most promising and advantageous manner. For not only would the subject of rhythms and their interpretations be advanced by reactions from multifarious individual experiences, but the stimulus of another hypothesis would lead to the discovery of unexpected meanings in stratigraphic detail.

It is one of the fortunate qualities of scientific research that its incidental and unanticipated results are not infrequently of equal or even greater value than those directly sought. Indeed, if it were not so there would be no utilitarian harvest from the cultivation of the field of pure science.

In advocating the adoption of a new point of view from which to peer into the mysterious past, I would not be understood to advise the abandonment of old standpoints, but rather to emulate the surveyor, who makes measurement to inaccessible points by means of bearings from different sides. Every independent bearing on the earth's beginning is a check on other bearings, and it is through the study of discrepancies that we are to discover the refractions by which our lines of sight are warped and twisted. The three principal lines we have now projected into the abyss of time miss one another altogether, so that there is no point of intersection. If any of them is straight, both the others are hopelessly crooked. If we would succeed we should not only take new bearings from each discovered point of vantage, but strive in every way to discover the sources of error in the bearings we have already attempted.

G. K. GILBERT.

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*THE EIGHTH GROUP OF THE PERIODIC SYSTEM AND SOME OF ITS PROBLEMS.**

I.

IN the early work of Newlands and of Mendeléeff, which subsequently developed into the periodic law, a serious difficulty was met with in dealing with iron, cobalt, nickel, and the metals of the platinum group. In Newlands' modified statement of his law of octaves he says: "The numbers of analogous elements, *when not consecutive*, differ by seven or by some multiple of seven." Thus we find him grouping † cobalt and nickel under a single number; so rhodium and ruthenium; so also platinum and iridium. Cobalt, nickel, palladium, plati-

*Address by the Vice-President and Chairman of Section C., American Association for the Advancement of Science, June, 1900.

† *Chem. News*, 13, 130 (1866).

num and iridium are considered by him analogous elements, each occupying the first place in the octave to which it belongs; iron, rhodium, ruthenium and gold are analogous elements, each occupying the seventh place in its octave; while osmium is included with copper and silver as the second members of their octaves. There was here an easily recognized inconsistency which was not cleared up till many years later Seubert was led by the study of the periodic law to revise the atomic weights of these metals.

In his first summing up of the principles of the periodic law in 1869, Mendeléeff concludes that "elements which are similar as regards their chemical properties have atomic weights which are either of nearly the same value (*e. g.*, platinum, iridium, osmium) or which increase regularly (*e. g.*, potassium, rubidium, cesium)"*. So in most schemes for representing the periodic system, each triplet of these elements is considered as a single element, and because even then they do not seem to fall into regular periodic arrangement, they are cast out, Ishmael-like, into an anomalous eighth group. This is doubtless the reason they have been relatively so much neglected by chemists, and possibly it is not incorrect to say that the chemistry of these metals is less known than that of any other group of well characterized elements. Yet there are certainly no nine nearly related elements which present so many interesting chemical problems, whose solution will so much further our knowledge of chemistry in general. It is the purpose of this address to attract the attention of the members of this Section to this group and some of its many problems.

The ordinary division of these nine metals is into three groups, viz, the common metals, iron, cobalt, and nickel, with an atomic weight of from 56 to 59 and a specific gravity of 7.8 to 8.9; the lighter platinum metals, ruthenium, rhodium and palladium, with an atomic weight 101.5 to 106.5 and a specific gravity of about 12; and the heavy platinum metals, osmium, iridium and platinum, of atomic weight 191 to 195 and specific gravity 21.5 to 22.5.

Jour. Phys. Chem. Soc. Russ., 1 (1869), 60.

Of these metals, iron alone can be considered abundant and was the only one known until the eighteenth century. The ores of cobalt and nickel have been known for over two centuries, but the probable presence of a new metal in cobalt ore was first pointed out by Brandt* in 1735, and nineteen years later Cronstedt† determined the existence of nickel. Both of these discoveries were several decades after confirmed by Bergman‡.

It is, however, a curious and interesting fact that a coin of Bactria§ of a date more than two centuries before Christ has been found containing twenty per cent. of nickel and hence quite similar in composition to our modern 'nickels.' There seem, however, to be no references in ancient literature which would indicate that attention was ever attracted by nickel or any of its compounds.

Turning to the platinum metals, the first recognized mention of platinum seems to be in the 'Relacion historica' of Don Antonio de Ulloa (vol. 1, lib. vi, cap. 10, p. 606) published first in 1748, the book being an account of the French expedition of 1735 to the western coast of South America to measure an arc of the meridian on the equator. The passage reads: "In the district of Chocó (Columbia) which contains many placer mines, are also found some, the gold of which, occurring mixed with other substances as metals and rocks, or

* *Akta Reg. Soc. Sci. Upsala* (1735), 33.

† *K. Svenska Vet. Akad. Handl.* (1751), 293.

‡ *Opusc. Diss.* 20 (1775), 24 (1780) 12 and 14, 25 (1779) 31 and 33.

§ *Ann. der Phys.* (Pogg.), 139, 507 (1870).

being enveloped in them, requires the use of quicksilver for its extraction; and sometimes ores are found which are not worked because of the *Platina* in them (a mineral of such resistance that it is not easy to break it, nor to crush it upon an anvil), for this substance is not affected by calcination, nor is there any means of extracting the metal which it contains, except at the cost of much labor and expense.

From the mention here made, platinum is evidently a well-known substance, and it is by no means improbable that earlier definite mention of platinum may yet be found. In this connection it is interesting to note that there have been many efforts to show that platinum was known at much earlier periods. Scherer* considers from a passage in Balbin's History of Bohemia (P. I., ch. xiv., p. 4) that platinum was known to the Bohemian Jesuits toward the end of the seventeenth century, occurring in the Riesengebirge, for he speaks of a kind of gold so white that one would swear it was silver,† were it not for its weight, ductility, infusibility and insolubility in nitric acid. Julius Scaliger's 'Exercitationes Exotericae de Subtilitate,' published at Frankfort in 1601, makes mention of an infusible metal found in the mines of Mexico and Darien, which might seem to indicate platinum.‡ There have been, moreover, a number of efforts to show that platinum was known to antiquity, under the names of *electrum* or of *plumbum candidum*. Cortinovis § considers that the electrum of the ancients was platinum, and proves it to his own satisfaction from the

* *Allg. J. Chem.* (Scherer), 6, 633 (1801).

† Aurum album, quod argentum esse jurares, nisi auro familiares proprietates aliud suaderent, pondus scilicet, extensibilitas, vis eludendi ignem et aquam fortem, solubilitas in aqua regia, etc.

‡ Praeteria scito infunduribus, qui tractus est inter Mexicum et Darien, fodinas esse auricalchi, quod nullo igni, nullis hispanicis artibus, hac tenus liquescere potuit.

§ Opuscoli Scelti Sulla Scienze, etc. Milano, 1760.

Bible, from classic historians of nature and art, from poetry and from Homer.* A similar view is held by Schweigger,† where Pausanius (5, chap. 12, p. 406. Ed. Casaub.) is quoted as mentioning electrum, from which Augustus had made columns, as occurring in nature in the sands of the river Eridanus, and as being very rare, hence much more valuable than the other kind of electrum which is merely an alloy of silver and gold. In 1850 Paravey makes ‡ a strong effort to show that Pliny when speaking in his Natural History of *plumbum candidum*, refers to platinum. Pliny speaks indeed of a lead, heavier and more ductile than gold and in Book 34, Chapter 16, gives a definite description of it. To use the quaint translation of Philemon Holland, Doctor of Physicke, published first in 1601:

"Now insueth the discourse of lead, and the nature of it; of which there be two principall kindes, the blacke, and the white. The richest of all, and that which carrieth the greatest price, is that which we in Latine name Plumbum candidum, *i. e.* the white bright lead and the Greeks Cassiteron. But I hold it a meere fable and vaine tale, that all of it is fetched as farre as from the Islands of the Atlanticke Sea, and that the inhabitants of those parts doe conveigh it in little twiggen boats, couered all ouer with feathers. For the truth is that there is found of it in these daies within Portugall and Gallaecia, growing ebbe upon the opmost face of the earth, being among the sands, of a black colour, and by the weight only is knowne from the rest of the soile: and here and there among, a

* As an instance of the views of Cortinovis may be cited the lines:

Atria cinxit ebur, trabibus solidatur ahenis
Culmen et in celsas surgunt *electra* columnas,

from Claudian's 'Rape of Proserpina' (Book I., v. 164) where it is considered that *electrum* must mean platinum.

† *J. prakt. Chem.*, 34, 385 (1845).

‡ *Compt. Rend.*, 31, 179 (1850).

man shall meet with small stones of the same stuffe, most of all within the brookes, that be dry sometimes of the yere. This sandie and grauelly substance, the mine masters and mettall finers use to wash, and that which settleth downeward, they burne and melt in the furnace. There is found likewise in the gold mines a kind of led ore which they cal Elutia; for that the water that they let into these mines (as I said before) washeth and carrieth down withall certain little blacke stones streaked and marked a little with a kind of white, and as heavy they be in hand as the very ore of gold; and therefore gathered they be with the same ore, and laid in the paniers together therewith; and afterward in the furnace when the fire hath made a separation between them and gold, so soone as they are melted do resolue into the substance of the white lead or tin glance aforesaid."

If Pliny's observation that this variety of *plumbum candidum* is as heavy as gold could be relied upon, the view would be plausible that he was cognizant of platinum, but unfortunately in other places he gives evidence of great inaccuracy in this respect. So too there seems no good reason for considering the metallic *electrum* to be anything other than the natural or artificial white alloy of gold and silver. If there were any question as to whether platinum were known to the ancients, it would seem to be completely answered in the negative by the fact that no platinum object, no nugget, or grain of platinum has been found among ancient remains.

Soon after the introduction of platinum into Europe, no inconsiderable amount of work was done upon it, by Watson, Scheffer, Lewis, Macquer, Marggraf, Bergman, Guyton de Morveau, and others. A few chemists, led by Buffon,* cast doubts upon its elementary character. Buffon when reading his history of minerals to the Dijon Academy held that platinum was an alloy of gold and iron, because it was attracted by a magnet, and, said he, if platinum be a metal there must be a second substance in nature attracted by a magnet. Von Milly believed that mercury was also present in the alloy, but Blondeau,* professor of mathematics at Brest, showed the great improbability that platinum was anything other than a simple metal.

* *Obs. sur. phys.* (Rozier), 3, 322 (1774).

The first suggestion of a practical use for platinum seems to have come from Lavoisier's † observation of its value for laboratory utensils. Many efforts were made in the last decade of the eighteenth century to fuse platinum or to get it into workable form. The first recorded success in this direction was that of Janetty,‡ a Parisian artisan who melted platinum by alloying it with arsenic. It was also alloyed with lead or with bismuth and then cupelled. Before 1800 l'abbé Rochon § wrapped grains of platinum in platinum foil, heated to redness and then hammered into an ingot. Moussin-Poushkin ‖ amalgamated platinum sponge with mercury and ignited in a muffle. Another process is described,¶ of wrapping ammonium chloroplatinate in platinum foil, igniting, and hammering. In 1800 Knight ** published his process which with some modifications was generally adopted and remained in use till the metal was fused in the flame of an oxyhydrogen blowpipe by Deville and Debray, more than half a century later. Knight's process consisted in heating platinum sponge in a nearly cylindrical but slightly tapering clay mould, and compressing it by

* *Ibid.*, 4, 154 (1774).

† *Annales de chim.*, 5, 137 (1790).

‡ *Chem. Ann.* (Crell), 1790, ii, 53. The name is also spelled Jeanty, Jeannety, and Jannety.

§ *Ann. der Phys.* (Gilbert), 4, 282 (1100).

‖ *Chem. Ann.* (Crell), 1799, ii, 359.

¶ *Phil. Mag.*, 21, 175 (1805).

** *Ibid.*, 6, (1800).

a few hammer blows while in the furnace. This gave a coherent platinum which could be readily worked into an ingot. It was just about the opening of the century that the discovery of platinum in the Ural Mountains occurred,* and the supply being thus very materially augmented, the use of platinum in the laboratory became established. At the same time the study of the metal from a chemical standpoint led to the discovery of several other metals in the platinum ores. No less than five of the distinguished chemists of that day were working on the ore, with the special aim of separating out other metals which they had reason to believe were present. Palladium was first obtained by Wollaston; Collet Descotils was the *first to publish* indications of what we now know to be iridium, and Fourcroy and Vauquelin at the same time had this metal in hand in an impure form. The real discoverer of iridium should be recognized in Smithson Tennant, who not only separated it in purity, but also at almost the same time found in the same residues the element osmium which seems to have been wholly overlooked by the French chemist. This chapter was closed a few months later by Wollaston's discovery of rhodium.

The episode of the discovery of palladium throws a curious light upon the chemistry and chemists of that period. On May 12, 1803, Chenivix read a paper before the Royal Society † stating that two weeks previously (April 29th) he learned by a printed notice that a substance announced as palladium, a new metal, was offered for sale at the establishment of a well-known mineralogist. The printed notice * opens: "Palladium, or new silver, has these properties among others which show it to be a new noble metal" and then follows the enumeration of eight characteristics of the metal, closing with the address where the new metal could be bought. Chenivix goes on to say that the mode adopted to make known a discovery of so much importance without the name of any creditable person, except the vendor, appeared to him unusual and not calculated to inspire confidence. Having examined a small sample, Chenivix returned and purchased the whole supply. He then says: "We shall cease to wonder at what has been related by these chemists (Berthollet on affinity and Hatchett on alloys), when we learn that palladium is not as was shamefully announced a new simple metal, but an alloy of platina; and that the substance which can thus mask the most characteristic properties of that metal, while it loses the greater number of its own is mercury. Chenivix however on May 4th had written † to Vauquelin that palladium really was a new metal and Chenivix sent him a small specimen. A few days later another letter ‡ makes the claim that palladium is a platinum-mercury alloy. The editors of the *Annales* comment upon this that from Vauquelin's experiments Chenivix is probably wrong. It is interesting to read the comments of Chenivix upon the masking of the individual properties of both platinum and mercury in palladium §, a correct moral drawn from

* Osann says (*Ann. der Phys.* (Pogg.) 11, 311 (1827)) that the first mention he can find of platinum in connection with the Ural Mountains is *Ann. de Chim.*, 60, 317 (1806), where Vauquelin speaks of a rumor that platinum has been discovered in Siberia. Osann could not trace the origin of this rumor.

† *Phil. Trans.*, 93, 290 (1803).

* *Ann. Chim.*, 46, 333 (1803).

† *Ann. de Chim.* 46, 333 (1803).

‡ *Ibid.*, p. 336.

§ "The substance which has been treated of in this paper, must convince us how dangerous it is to form a theory before we are provided with a sufficient number of facts, or to substitute the results of a few observations for the general laws of nature. If a theory is sometimes useful, as a standard to which we may refer our knowledge, it is at other times prejudicial, by creating an attachment in our minds to

a false premise. There was something almost prophetic in the observations of Chenivix, for there are in chemistry no elements whose properties exhibit such great variability when not pure, as do those of the platinum group.

The still anonymous discoverer of palladium immediately offered through Nicholson's Journal a reward of twenty pounds sterling to any one who should manufacture even twenty grains of real palladium,* and many chemists entered into the discussion as to the elementary character of the metal. On June 24, 1804, three days after Tennant had made known the discovery of iridium and osmium, Wollaston read a paper before the Royal Society* acknowledging himself to be the discoverer of palladium. Wollaston had been engaged in an effort to obtain malleable platinum, and having precipitated his solution of the ore with iron, he found a part of this precipitate to be soluble in a mixture of hydrochloric acid with saltpeter, potassium chlorpalladate being formed. He at once concluded that palladium must be a simple metal, because there is 'no instance in chemistry of a distinctly crystallized salt containing more than two bases combined with one acid,' another correct conclusion drawn from a false premise. In his solution Wollaston found also indications of rose-colored soluble crystals which he attributed to another new metal, and to this he gave the name rhodium. This is the explanation of his curious method of making known his discovery of palladium: "On this and on other accounts I endeavor to reserve to myself a deliberate examination of these difficulties, which the subsequent discovery of a second new metal, that I have called rhodium, has since enabled me to explain, without being anticipated even by those foreign chemists whose attraction has been particularly directed to this pursuit."† It is possible from this that Wollaston himself had been led to his work in part at least by the earlier observations of the French chemists.‡

preconceived ideas, which have been admitted without inquiring whether from truth or from convenience. We can easily correct our judgment as to facts and the evidence of experiment is equally convincing to all persons. But theories, not admitting of mathematical demonstration, and being but the interpretation of a series of facts, are the creatures of opinion, and are governed by the various impressions made upon every individual. Nature laughs at our speculations; and though from time to time we receive such warnings as should awaken us to a due sense of our limited knowledge, we are presented with an ample compensation, in the extension of our views, and a nearer approach to the immutable truth." *Phil. Trans.* 93, 317 (1803).

* "Dec. 19, 1803. Editor Nicholson's Journal. Sir: As I see it said in one of your Journals that the new metal I have called palladium is not a new noble metal as I have said it is, but an imposition and a compound of platina and quicksilver, I hope you will do me the justice in your next and tell your readers I promise a reward of £20, now in Mrs. Foster's hands, to any one that will make only 20 grains of real palladium, before any three gentlemen chemists you please to name, yourself one if you like. That he may have plenty of his ingredients, let him use 20 times as much quicksilver, 20 times as much platina, and in short of anything else he pleases to use; neither he nor I can make a single grain. Pray be careful in trying what it is he makes, for the mistake must happen by not trying it rightly. My reason for not saying where it was found was that I might make some advantage of it as I have a right to do. * * * I hope a little bit of whatever is made may be left with Mrs. Foster." Nich. J. 7, 75, 159 (1804).

* *Phil. Trans.*, 94, 419 (1804).

† Nicholson's J., 10, 204 (1805).

‡ Since this address was in type, I have received the interesting Presidential Address of Dr. Thorpe to the Chemical Society (London), in which this episode is treated quite exhaustively. What Wollaston's motive was in bringing his discovery to the notice of the scientific world in so extraordinary a manner, Dr. Thorpe says can only be surmised. Is not however, in view of Wollaston's statement, the motive clearly apparent? He had found palladium; he was in pursuit of rhodium; he knew that at least four other distinguished chemists were also on track of new metals in platinum residues, and any hint such as the publication of his work on palladium

It was in 1803 that Collet-Descotils had read a paper before the Institute of France on the cause of the different colors which affect certain salts of platinum. The residue from the solution of platinum ores in aqua regia and which was thought to be graphite, was still slightly soluble in aqua regia and gave a reddish tint to the potassium chlorplatinate made from it. The metal derived from this red salt was found to be only partially soluble in aqua regia and hence beyond question Descotils had in hand on several occasions a fairly pure iridium, containing, however, in addition to platinum perhaps traces of rhodium. He was convinced that he had here a new metal but he did not investigate its properties.*

The same day that Descotils spoke before the Institute, a second paper on the same subject was presented by Fourcroy and Vauquelin. After extracting the platinum from the ore by aqua regia, they fused the residue with potash and then treated it with acid. These chemists noticed that the potash was colored orange-yellow, but ascribed it to the presence of chromium. They thus missed the discovery of ruthenium, which was to be separated several decades later by Claus. They noticed also on one occasion that the black powder which consisted of iridium and allied metals, was apparently volatile, not recognizing osmium, the cause of the phenomenon. In their second memoir they had iridium fairly pure, and they too noticed the rose color of the double salt, but did not investigate the cause, which is the presence of rhodium.

would help them to anticipate him in the matter of rhodium, while if he kept silence, some of them could not fail to discover palladium.

*Of this Descotils writes (*Ann. de Chim.* 48, 165 1803): On peut déjà conclure que la coloration en rouge des sels de platine est due à l'oxigénation d'une substance qui diffère du platine, et qui présente, lorsqu'elle est a l'état metallique, une grande résistance à l'action des acides.

It was reserved for Tennant the following year to describe clearly the separation of iridium and osmium from the platinum residues, and to name the one from the many different colors through which its chlorids pass, and the other from the intolerable odor of its tetroxid OsO_4.

This osmium contained ruthenium but this was overlooked by Tennant, as it had been by Fourcroy and Vauquelin. A few years later Vauquelin* notes that osmium solutions give a beautiful blue color when reduced by zinc, this being a characteristic reaction, not of osmium but of ruthenium. At a still later date Berzelius noticed the orange color of the fusion of ruthenium with potash and saltpeter, but he attributed it to iridium.

It was in 1828 that the next effort was made to add to the number of the platinum metals. Professor Osann, of the University of Dorpat, announced† the discovery of a new metal in the platinum residues. He obtained long reddish prisms, with high luster, which were easily volatile and which Berzelius pronounced to be new. He had only 0.3 gram, and never obtained any more. The metal in these crystals he named *ruthenium*. They may have been an impure mixture of the tetroxids of ruthenium and osmium. In the next volume of the Annalen‡ he transfers the name ruthenium to another new metal with a golden luster, and at the same time he mentions two other metals, *pluran*, named from pl (atina) and ur (al), which is not further described, and *polin* (πολίος, gray), a gray metal of whose independent existence he seems to have some doubt. Polin was impure iridium with perhaps some ruthenium; pluran was quite possibly a mixture containing some ruthenium; the following year§

* *Ann. de Chim.*, 89, 241 (1814).

† *Ann. der phys.* (Pogg.), 13, 287 (1828).

‡ *Ann. der phys.* (Pogg.), 14, 340 (1828).

§ *Ibid.*, 15, 158 (1829).

Osann acknowledged the metal to which the name ruthenium had been given to be a mixture of the oxids of titanium, zirconium, and silicon.

Fifteen years pass and there appears at the University of Kazan, almost on the far eastern frontier of Russia, a chemist, Claus, who is destined to make greater contributions to the chemistry of the platinum metals, not only than those who had preceded him, but than any one of those who have lived in the nearly forty years since his death. Claus was fortunate in having at his disposal an almost unlimited quantity of platinum residues, from the stock which had accumulated at St. Petersburg during the period of the coinage of platinum. In spite of no inconsiderable effort, I have failed to verify the tradition that the great mass of these residues was sunk in the Neva, to prevent their use in debasing the coinage, and I am inclined to think that the greater portion was distributed to chemists, of which Claus received by far the largest share. In his first publication,* Claus announces the discovery of a new metal, which he calls ruthenium, for the purpose of honoring Osann, whose ruthenium had failed to prove itself an element. It may be mentioned that Osann hardly appreciated the compliment, for he attacked Claus with considerable asperity, accusing him of claiming to discover what Osann himself had discovered. To an impartial critic Osann wholly fails to make out his case. For nearly twenty years Claus continued his work, and his greatest service was in definitely settling the position of the six platinum metals among the elements.† He was the first who clearly showed that these six metals belong in a group by themselves. Up to this time many had held that platinum belonged with gold, palladium with silver, and ruthenium with tin.* He then arranges the elements in three pairs and in two series † as we find them in every table to-day. He also speaks of ruthenium and osmium being especially close to iron, an analogy hardly acknowledged even after the periodic tables of different chemists had appeared. He adds that while platinum is not in the group with gold, it is closely related to it.

* *Bull. Akad. St. Petersb.* 3 (1845), 38.

† *Ibid.* [2] 2 (1860) 160.

Since the time of Claus no new metals have been found in platinum ore or belonging to the platinum group, which have been generally acknowledged as elements. Several chemists have, however, found what they have believed to be new elements, but the quantity has generally been so small that its verification has been impossible. In 1852 Genth ‡ found two grains of a white metal in platinum from California gold. Its properties were unlike those of any known element.

In 1862 Dr. C. F. Chandler § described a new metal in native platinum from Rogue River, Oregon; this possessed properties very similar to those described by Genth, and Chandler concludes that his metal is probably identical with that found by Genth.

In 1869 Guyard discovered a metal in Russian platinum which he described ten years later,|| and called ouralium. It resembles platinum but is softer and has an

* Loc. cit. "Es is nicht zu leugnen, das in Beziehung einiger weniger Eigenschaften sich solche Analogien aufstellen lassen, allein ich habe Grund diesen nur einen geringen Werth beizumessen, und schliesse mich daher entschieden dem ersten Theile der Anschauungsweise der Verfasser an, indem ich, wie ich mich auch bisher ausgesprochen habe, die Platinmetalle alle für Glieder einer untrennbaren, wohlbegründeten Metallgruppe halte."

†

+ end of the horizontal series.	Principal Series	Os.	Ir.	Pt.	Vert'cl Series.	— end of the horizontal series
	Secondary Series.	Ru.	Rh.	Pd.		

‡ *Proc. Acad. Sci. Phil.* 6 (1852), 209; *Amer. J. Sci.* [2], 15 (1853), 446.

§ *Am. J. Sci.* [2], 32 (1862), 351.

|| *Monit. Scient.* [3], 9 (1879), 795.

atomic weight of 187.5. Its chief difference from platinum is that when fused with potassium cyanide, the melt is orange. This work of Guyard's has never been confirmed.

In 1877 Sergius Kern* announced the discovery of a new metal in platinum residues with atomic weight of 154, to which he gave the name of davyum. This has not only not been confirmed but recently Mallet† has gone over the whole ground with great care, and has shown that in all probability Kern's davyum is a mixture of iridium with rhodium and a little iron. Mallet obtained a residue in much the same way as Kern with similar properties and atomic weight, but proved it to be a mixture. This is the more significant since 154 would be the anticipated atomic weight of a metal lying between the lighter and heavier metals of the group.

The great influence of one of the metals of this group upon the properties of another, even if present in but small quantities, has already been alluded to. It has been long known and a very considerable series of experiments on this point is described by Claus.‡ Nevertheless it remains true that a good proportion of the workers on these metals have, for a time, at least, supposed themselves discoverers of new elements. We may say, however, that not yet is there any reliable evidence of any new metal between the two series, that is, with an atomic weight of about 150; nor has there been any trace of *eka-manganese*, with its atomic weight of 100, and which some chemists would expect to find resembling the platinum metals in its properties.

It is by no means impossible that new metals may be discovered in this group, but the fact that in more than half a century, no confirmed discovery of such has taken place, and that had it not been for a misinterpretation of reactions by which ruthenium was overlooked, we might say that it lacked but three years of a century since a new metal has been discovered, is not calculated to give us much encouragement. There does, indeed, seem, according to the periodic table, to be a place for three metals of atomic weight near 150, but it hardly seems probable that such occur in any of the known platinum ores which have been so thoroughly investigated, unless it be in extremely minute quantity. There is, however, always the possibility of the discovery of new platinum ores, differing in character from those now known, which, whether from the Ourals, or Colombia, or from the Pacific coast, are approximately the same in composition.

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(*To be concluded.*)

* *Chem. News*, 36 (1877), 4, 92, 114, 155, 164; 37 (1878), 65.

† *Am. Chem. J.*, 20 (1898), 776.

‡ C. Claus; Beiträge zur Chemie der Platinmetalle, Dorpat, 1854, chap. iv. Modificationen, welche die ursprünglichen Reactionen der einzelnen platinmetalle durch Beimengungen der übrigen Metalle aus dieser Gruppe erfahren, p. 42.

THE ROYAL SOCIETY OF CANADA.

THE nineteenth meeting of the Royal Society of Canada was held in Ottawa, Canada, from May 28th to May 31st inclusive, in the Assembly Hall and rooms of the Provincial Normal School. Besides fellows of the Society from various provinces there were delegates from affiliated societies in all parts of the Dominion of Canada who reported as to the work done by them. Rev. Professor Clark, the able principal of Trinity University, Toronto, delivered the annual address 'On the Work of the Royal Society.' Numerous papers bearing upon history, science and belles-lettres were read.

Dr. L. O. Howard, the eminent economic entomologist from Washington, delivered a most practical and admirably illustrated lecture, on the evening of May 31st, His